Description

Brush system for an electromotive drive unit

The invention relates to a brush system for an electromotive drive unit and to an electromotive drive provided with a brush system of this kind.

In electromotive drives, stepped speed control is implemented using a resistor circuit. During operation, electrical energy is converted into thermal energy by said resistor circuit. This thermal energy may have a negative effect on the electromotive drive in respect of its service life. Overheating of the drive and increased drive component wear may occur. If the resistor circuit is disposed inside the motor, an air flow suitable for cooling cannot generally be guaranteed. This leads to an unwanted heat concentration in sections of the resistor circuit or in the drive as a whole, which may ultimately result in component failure.

To dissipate or remove the thermal energy produced, a known solution is to use cooling fins, large-area heatsinks or supplementary ventilation. Another known solution is to increase the service life by using more temperature-resistant, more durable and therefore more costly drive components.

DE 101 29 234 A1 discloses an electric drive unit comprising a gear housing, a motor housing, a separately implemented, watertight-sealed electronics housing, a brush holder and a signal receiver disposed on said brush holder. The brush holder

is provided with plug contacts to which electronics provided in the electronics housing are electrically connected. In addition, the brush holder is fixed to the motor housing at the transition between the motor housing and the gear housing. No references to any kind of cooling measures are to be found in DE 101 29 234 A1.

The object of the invention is to demonstrate a way of effectively removing heat energy created in an electromotive drive.

This object is achieved using a brush system having the features set forth in Claim 1. Advantageous embodiments and developments of the invention are detailed in the dependent Claims 2 - 15. Claim 16 refers to an electromotive drive having a brush system according to one of Claims 1 - 15.

The advantages of the invention are in particular that, through the incorporation of the resistor unit in the brush system and the special embodiment of the resistor unit as a flat resistor contained in a resistor housing provided with air passage openings, the air flow necessary for dissipating the thermal energy produced can be better ensured than with known drive systems. In addition, the flat implementation of the resistor unit and its incorporation in the brush system provides a compact, space saving design.

The features specified Claim 2 mean that the brush system can be slid over the motor shaft and attached to the motor housing, thereby likewise ensuring a space saving design as well as

reliable contact-making of the carbon brushes with the commutator segments of the electric motor.

By means of the features set forth in Claims 3 and 4, a space saving disposition of the resistor unit in the brush system is achieved with optimum adaptation of the resistor unit to the shape of the base plate of the brush system.

The features detailed in Claim 5 allow the resistor unit to be quickly and easily inserted in the brush system.

The connecting lugs specified in Claim 6, which are each preferably inserted in an associated receiving pocket of the resistor housing, provide a simple means of contact between the resistor circuit contained in the resistor housing and an associated conductor on the base plate of the brush system.

According to Claim 7, the air passage openings are holes or slits. These can advantageously be ready-made in the resistor housing during the resistor unit manufacturing process, care obviously having to be taken to ensure that the resistor circuit provided inside the resistor housing is not damaged.

If the resistor housing is made of aluminum, as specified in Claim 8, or some other light metal, the entire brush system can be of lightweight construction.

By means of the features specified in Claims 9, 10 and 12 there is advantageously achieved an increase in the total

surface area of the resistor housing available for heat dissipation.

The air flow deflecting elements specified in Claim 11 allow selective guidance of the air stream so as to enable heat to be effectively removed from strongly heat generating components and also to prevent removed heat from being conducted in the immediate direction of heat-sensitive components.

The resistor circuit contained in the resistor housing can be a resistor film, a meander-shaped flat resistor or a resistor wire installed in a meandering manner.

The gas-, liquid- and particle-tight implementation of the resistor housing specified in Claim 14 has the advantage that the components inside the housing are protected from corrosion and other damage caused by gases, liquids or particles present in the engine compartment.

An embodiment of the resistor housing as claimed in Claim 16 allows an escape of gases, liquids or more precisely moisture and particles which have penetrated the resistor housing in an undesirable manner during the production and use of the resistor unit.

Further advantageous characteristics of the invention will emerge from their exemplary explanation with reference to the accompanying drawings in which:

Figure 1 shows a schematic view of the electromotive drive components essential for understanding the invention,

Figure 2 shows a more detailed schematic view of the brush system 6 of system 1,

Figure 3 shows a schematic rear view of the brush system 6 illustrated in Figure 2 and

Figure 4 shows a schematic view for explaining a development of the invention.

Figure 1 shows a schematic view of the electromotive drive components essential for understanding the invention. An electromotive drive of this kind has a motor housing (not shown) in which permanent magnets 1 are disposed. The motor housing and the permanent magnets constitute a stator. In addition, the electromotive drive contains an armature 2 on which coils 3 are provided. The armature 2 also comprises an armature shaft 4 on which a commutator with commutator segments 5 is mounted, said commutator segments being electrically connected to the windings of the coils 3.

The electromotive drive illustrated additionally has a brush system 6 which, in the assembled state of the drive, is positioned around the shaft 4 in such a way that it is immediately adjacent to the commutator segments. When installed, this brush system 6 is fixed to the motor housing.

In addition, in the installed state of the drive, the armature shaft 1 is mechanically coupled to a fan wheel 7 and drives same. The fan wheel 7 is so designed that, when it rotates with the shaft 4, air flows in the direction indicated by the arrow 8, i.e. essentially parallel to the shaft 4 of the electromotive drive.

By means of a special embodiment of the brush system 6, which will be explained in greater detail below with reference to Figures 2 - 4, it is ensured that at least part of the air flow produced by the fan wheel 7 effectively removes the heat energy generated from the motor.

Figure 2 shows a more detailed schematic view of the brush system 6 of Figure 1. The brush system 6 illustrated has a base plate 9 made of a non-electrically conductive material such as bakelized paper or plastic. The base plate 9 has an essentially discoidal, preferably circular discoidal basic shape and is provided with a cut-out 18 in its central area.

On the base plate 9 are mounted brush holder support elements 10 which are implemented e.g. as brush yokes. Inside these brush holder support elements 10 are mounted the carbon brushes which, in the operating state, make contact with the commutator segments 5. Also mounted on the base plate 9 are interference suppression elements such as chokes 11 and capacitors. On the base plate 9 there is additionally provided a mating connector 12 via which the brush system can be electrically contacted to an external voltage supply. The necessary electrical connections of the components mounted on

the base plate 9 between one another and to other components are established via conductors 13 provided on the base plate. These conductors can be implemented in the form of a leadframe stamped from a metal sheet, as a circuit board or as individual conductor tracks either injected into the base plate or subsequently mounted on same. Hereinafter it will be assumed that the conductors are implemented as conductor tracks.

According to the present invention there is incorporated in the brush system 6 a resistor unit having a resistor housing 14 and, provided in said resistor housing, a flat resistor arrangement hereinafter referred to as a flat resistor. Said flat resistor is a resistor foil, a meander-shaped flat resistor or a resistor wire disposed in a meandering manner. This flat resistor is used as part of stepped speed control of the electromotive drive.

The resistor housing 14 has an essentially discoidal, preferably disk-segment-shaped basic form and consists of a light metal, preferably aluminum. This allows the entire brush system to be of lightweight design.

As shown in Figures 2 and 3, the resistor housing 14 is an integral part of the brush system 6. The resistor housing 14 is disposed in the same plane as the base plate 9 and is inserted in a form-fit manner in another, preferably disk-segment-shaped cut-out in the base plate 9. The resistor housing 14 is attached to the base plate 9 by means of snap-in connections 17 into which the resistor housing is snapped

after its insertion. The resistor housing is inserted in the cut-out in the base plate from the underside of the base plate.

The necessary electrical contacting of the terminals of the flat resistor disposed in the resistor housing 14 is effected using connecting lugs 16 which are pushed into the receiving pockets 20 of the resistor housing 14. The connecting lugs 16 connect the terminals of the flat resistor to one of the conductor tracks 13 in each case. For example, one of the conductor tracks connects one terminal to an external power supply cable plugged into a contact of the connector 12 of the brush system 6. In addition, another of the conductor tracks 13 connects the other terminal of the flat resistor to one of the carbon brushes via one of the interference suppression elements 11.

In order to be able to ensure good aeration and therefore good heat dissipation, the resistor housing 14 has a plurality of air passage openings 15. These can be holes or slits ready-made in the housing during manufacture of the resistor unit 14. The more aeration is required, the larger the number of air passage openings can be. Alternatively or additionally, the size of the air passage openings can also be varied.

Considering Figures 1 and 2 in conjunction, it is apparent that the air passage openings 15 are disposed in such a way that they allow the unrestricted passage of the air flow caused by the rotation of the fan wheel 7, thereby

effectively dissipating the heat generated by the resistor unit.

Effective removal of the heat produced by the resistor unit is also assisted by the large-area, thermally conductive housing 14 which passes heat generated within the resistor housing to ambient.

In order to improve the heat dissipation still further, the resistor housing 14 is preferably provided with surface-enlarging extensions such as beads or flanges. In addition, these surface-enlarging extensions can also be air flow deflecting elements.

An example of an air flow deflecting element of this kind is illustrated in Figure 4. This is a sectional view showing one of the holes 15 and the parts of the resistor housing 14 above and below the hole. In addition, the arrows 8 indicate the air flow direction. It can be seen that the air directed through the hole 15 in the resistor housing is diverted by the air flow deflecting element 19 and has a different flow direction on leaving the air flow deflecting element. By using air flow deflecting elements of this kind, the flow direction of the air can be influenced, making it possible to direct more heat-dissipating air into areas containing components which generate a large amount heat.

A surface-enlarging extension of the resistor housing 14 can also advantageously connect the resistor housing to the housing of the motor. Consequently, heat is also dissipated

via the motor housing, a measure which also counteracts overheating of the drive unit.

According to one embodiment of the invention, the resistor housing can be made gas-, liquid- and particle-tight. This has the advantage of preventing gases, liquids or particles present, for example, in the engine compartment of a motor vehicle in which the drive unit is located from damaging the components contained in the housing during operation of the drive unit. In particular, this prevents corrosion from occurring.

According to another embodiment of the invention, the resistor housing can also be implemented in an open manner. This open design of the resistor housing has the advantage that gases, liquids or more precisely moisture and particles which get into the resistor housing during the production process and during operational use in an undesirable manner are also easily removed from it again.

The invention thus relates to a brush system which can be used in an electromotive drive. The brush system has a base plate, brush holder support elements mounted on said base plate and interference suppression elements. Additionally provided on the base plate are conductors via which the necessary electrical connections are established. The resistor unit containing a flat resistor disposed in a resistor housing is inserted in the base plate, fixed to same and placed in contact with the conductors. The resistor housing has air passage openings which facilitate an air flow caused by the rotation of a fan wheel.

By means of this air flow, generated heat, particularly heat produced during the operation of the flat resistor, is dissipated in an effective manner.